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EXAMINER	
NOGUEROLA, ALEXANDER STEPHAN	
ART UNIT	PAPER NUMBER
1753	

DATE MAILED: 05/08/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/733,857	Applicant(s) MILES ET AL.
	Examin r ALEX NOGUEROLA	Art Unit 1753

-- Th MAILING DATE of this communication app ars on th cov r sh et with th correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 25 February 2003 .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-6 is/are pending in the application.

4a) Of the above claim(s) ____ is/are withdrawn from consideration.

5)☐ Claim(s) ____ is/are allowed.

6)☒ Claim(s) 1-6 is/are rejected.

7)☐ Claim(s) ____ is/are objected to.

8)☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 08 December 2000 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on ____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). ____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

Response to Amendment

1. Applicant's amendment of February 25, 2003 does not render the application allowable.

Response to Arguments

2. Applicant's arguments filed February 25, 2003 have been fully considered but they are not persuasive. Applicant alleges that Morishima, alone, or in combination with McBride et al. and Bakewell et al., does not disclose Applicant's claimed invention. The examiner respectfully disagrees. Morishima teaches an apparatus and method for combined electrophoresis and dielectrophoresis on a microfluidic chip. A positive electrode as required by Applicant's independent claims 1 and 3 is clearly implied by the "cross" at the left end of the bottom view of Figure 1. One with ordinary skill in the art would recognize the "cross" symbol to represent a positive electrode, especially since it is labeled "DC voltage for CE [capillary electrophoresis]". A negative electrode as required by Applicant's independent claims 1 and 3 is clearly implied by the stack of small line segments of decreasing length at the right end of the bottom view of Figure 1. One with ordinary skill in the art would recognize this stack of line segments forming an inverted triangle to represent a "ground" electrode. Interdigitated electrodes as claimed are clearly shown and, indeed, labeled as such, in Figures 1 and 2. Means for producing an AC voltage across the interdigitated electrodes are implied or represented by the encircled sine wave, the conventional symbol for an AC voltage source, shown at the right end of the bottom view of Figure 1 and labeled as "High Frequency Electric Field for DEP [Dielectrophoresis]". As for

Applicant's independent claim 6, Morishima discloses in the "Theory" section on page 270 of Morishima that the dielectrophoresis field allows tunable separations of particles, which includes trapping of particles. Indeed, Figure 4 shows trapped particles.

Status of the Objections and Rejections Applied in the Office Action of December 05, 2002

3. All of the objections to the claims are withdrawn.

4. All of the rejections under 35 USC § 112, second paragraph, are withdrawn.

5. All of the rejections under 35 USC § 102(a) and 35 USC § 102(a) are withdrawn, but have been reapplied, below, in light of Applicant's amendment.

Claim Rejections - 35 USC § 112

6. Claims 1-6 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention:

a) Claim 1: it is not clear whether the interdigitated electrodes (electrodes with projecting

legs) of the fifth paragraph of the claim are the same as the electrodes with projecting legs of the seventh paragraph of the claim;

b) Claim 3: it is not clear whether the interdigitated electrodes (electrodes with projecting legs) of the fourth paragraph of the claim are the same as the electrodes with projecting legs of the sixth paragraph of the claim;

c) Claim 6, line 6: the first occurrence of "electrode" should be replaced with -- second --; and

d) Claim 6: the sweeping and applying steps appear incompatible. How can the AC voltage sweep particles through the microchannel and trap them at the same time?

7. Note that dependent claims will have the deficiencies of base and intervening claims.

Claim Rejections - 35 USC § 102

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

9. Claims 1, 3, 5, and 6 are rejected under 35 U.S.C. 102(a) as being anticipated by Morishima et al. ("Novel Separation Method on a Chip Using Capillary Electrophoresis in Combination with Dielectrophoresis", Micro Total Analysis Systems 2000, 269-272, May 14-18, 2000).

Addressing Claim 1, Morishima et al. teach an apparatus for dielectrophoretic concentration of particles under electrokinetic flow (the abstract), comprising

a microfluidic channel section, the microfluidic channel section having a first end and a second end (Figures 1 and 2);

means for producing electrokinetic flow in the microfluidic channel section by producing a DC voltage across said first and said second end of microfluidic channel section (implied by Figure 1, which shows "DC voltage for CE"), said means for producing electrokinetic flow in the microfluidic channel section by producing a DC voltage across the first end and the second end of the microfluidic channel section comprising

a positive electrode connected to the first end of the microfluidic channel section (a positive electrode is clearly implied by the "cross" at the left end of the bottom view of Figure 1. One with ordinary skill in the art would recognize the "cross" symbol to represent a positive electrode, especially since it is labeled "DC voltage for CE [capillary electrophoresis]") and a negative electrode connected to the second end of the microfluidic channel section (a negative electrode is clearly implied by the stack of small line segments of decreasing length at the right end of the bottom view of Figure 1. One with ordinary skill in the art would recognize this stack of line segments forming an inverted triangle to represent a "ground" electrode.) and a DC power

supply connected to the positive electrode and the negative electrode (implied or represented by "DC Voltage for CE" in Figure 1),

at least one pair of interdigitated electrodes located on a surface of each said microfluidic channel (Figures 1 and 2); the interdigitated electrodes comprising a first electrode plate having first electrode projecting legs and a second electrode plate having second projecting legs, the first electrode projecting legs and second projecting legs interlaced (Figures 1 and 2); and

means for producing the combination of dielectrophoresis and electrokinetic/electroosmotic flow by producing an AC voltage across the interdigitated electrodes (implied by Figure 1, which shows "High Frequency Electric Field for DEP [dielectrophoresis]"), the means for producing the combination of dielectrophoresis and electrokinetic/electroosmotic flow comprising an AC power supply connected to the first electrode plate having first electrode projecting legs and the second electrode plate having second electrode projecting legs which sets up a non-uniform electric field proximate the first electrode plate having first electrode projecting legs and the second electrode plate having second electrode projecting legs, the non-uniform electric field collecting the particles (Figures 1 and 2).

Addressing Claim 3, the claim limitations may be found in the abstract and Figures 1 and 2. A means for applying an AC voltage as claimed is implied by the "High Frequency Electric Field for DEP" in Figure 1. Also see the rejection of claim 1 above, as many of the limitations of claim 3 are also in claim 1 and have been addressed in detail in the rejection of claim 1.

Addressing Claim 5, interdigitated electrodes as claimed may be seen in Figures 1 and 2.

Addressing Claim 6, Morishima et al. teach a method for concentrating particles under electrokinetic flow/eletroosmotic flow (the abstract), comprising

forming at least one pair of interdigitated electrodes on a fluidic microchannel having a multiplicity of first electrode projecting legs and a second multiplicity of second electrode projecting legs (Figures 1 and 2);

positioning at least one pair of interdigitated electrodes so that the first electrode projecting legs and the second electrode projecting legs are interlaced (Figures 1 and 2), and

sweeping the particles through the fluidic microchannel by

applying an AC voltage across the interdigitated electrodes to establish a non-uniform electric field capable of trapping particles using the dielectrophoretic force (implied by the "High Frequency Electric Field for DEP" in Figure 1);

controlling the voltage applied to each pair of interdigitated electrodes (implied by "Theory" section on page 270, which teaches '"tunable" separations based on the dielectric properties of the analytes.'), and

applying a DC voltage across ends of the fluidic microchannel to initiate an elecrtokinetic/electroosmotic flow field (note "DC voltage for CE [capillary electrophoresis]" in Figure 1).

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

12. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

13. Claims 1-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over McBride et al. (US 6,296,752 B1) in view of Becker et al. (US 6,287,832 B1), Bakewell et al.

("Characterisation of the dielectrophoretic movement of DNA in micro-fabricated structures", Inst. Phys. Conf. Ser. No. 163, January, 1999, pp.73-76).

Addressing Claim 1, McBride et al. teach an apparatus for dielectrophoretic concentration of particles under electrokinetic flow (Figure 4; col. 3, ll. 47-55; and col. 5, ll. 45-52), comprising

a microfluidic channel section, the microfluidic channel section having a first end and a second end (Figures 1 and 2);

means for producing electrokinetic flow in the microfluidic channel section by producing a DC voltage across said first and said second end of microfluidic channel section (electrodes 16A and 16B in Figure 4), said means for producing electrokinetic flow in the microfluidic channel section by producing a DC voltage across the first end and the second end of the microfluidic channel section comprising

a positive electrode connected to the first end of the microfluidic channel section (16A or 16B) and a negative electrode connected to the second end of the microfluidic channel section (16B, when the positive electrode is 16A, or 16A, when the positive electrode is 16B) and a DC power supply connected to the positive electrode and the negative electrode (implied by col. 3, ll. 47-51, which states that electrodes 16A and 16B are used to "all or a substantial part of the field the moves the molecules."),

at least one series of electrodes located on a surface of each said microfluidic channel (electrodes 1 in Figure 4); and

means for producing an AC voltage across the series of electrodes (col. 1, ll. 41-54).

McBride et al. do not mention having the series of electrodes in the form of at least a pair of interdigitated electrodes. However, at the time of the invention several configurations for dielectrophoresis electrodes, including at least one pair of interdigitated electrodes, was known. See for example Figure 1B and col. 3, ln. 55 – col. 4, ln.16 in Becker et al. and the abstract and Figure 1 of Bakewell et al. Barring evidence to the contrary, such as unexpected results, the choice of electrode configuration for the dielectrophoresis electrodes is just a matter of optimizing the apparatus for the intended analyte, which is implied and stated by Becker et al. in col. 5, ln. 52 – col. 6, ln. 4 and col. 14, ln. 50 – col. 15, ln. 10 (especially col. 14, ln. 67 – col. 15, ln. 2), where there is a discussion on how to optimize the structure, arrangement, and use of the electrodes. It would have been obvious to one with ordinary skill in the art at the time the invention was made provide a plurality of pairs of interdigitated electrodes in the microfluidic channel as taught by Bakewell et al. or Becker et al. in the invention of McBride et al. to, for example, optimize the apparatus for nucleic acid analysis (col. 14, ll. 40-49 in Becker et al. and the abstract in Bakewell et al.).

Addressing Claims 2 and 4, Bakewell et al. (Figure 1) and Becker et al. (col. 14, ll. 59-64) both teach providing a plurality of electrode sets. Again, this is just a matter of optimizing the apparatus. See in Becker et al. col. 14, ll. 59-64.

Addressing Claim 3, see the rejection of claim 1 above, as the limitations of claim 3 are also addressed by the detailed rejection of claim 1.

Addressing Claim 5, interdigitated electrodes as claimed may be see in Figure 1 of Bakewell et al. and Figure 1B of Becker et al.

Addressing Claim 6, McBride et al. teach a method for concentrating particles under electrokinetic flow (the abstract, Figure 4, and col. 3, ll. 47-55), comprising

forming at least one series of electrodes on a fluidic microchannel through which particles are swept electrokinetically (Figures 1 and 4);

applying an AC voltage across the series of electrodes to establish a non-uniform electric field capable of trapping particles using the dielectrophoretic force (col. 1, ll. 41-54). McBride et al. do not mention having the series of electrodes in the form of at least a pair of interdigitated electrodes,

controlling the voltage applied to the electrodes (implied by col. 3, ll. 51-55, which states, "Electrodes **1** can serve to create changes that add to the molecular discrimination provided by the electrophoretic movement driven by first external electrode **16**A and second external electrode **16**B."), and

applying a DC voltage across ends of the fluidic microchannel to initiate an electrokinetic/electroosmotic flow field (implied by col. 3, ll. 47-55, which teaches that electrodes **16**A and **16**B are for causing electrophoretic movement of the particles).

McBride et al. do not mention interdigitated electrodes. However, at the time of the invention several configurations for dielectrophoresis electrodes, including at least one pair of interdigitated electrodes, were known. See for example Figure 1B and col. 3, ln. 55 – col. 4,

ln.16 in Becker et al. and the abstract and Figure 1 of Bakewell et al. Barring evidence to the contrary, such as unexpected results, the choice of electrode configuration for the dielectrophoresis electrodes is just a matter of optimizing the apparatus for the intended analyte, which is implied and stated by Becker et al. in col. 5, ln. 52 – col. 6, ln. 4 and col. 14, ln. 50 – col. 15, ln. 10 (especially col. 14, ln. 67 – col. 15, ln. 2), where there is a discussion on how to optimize the structure, arrangement, and use of the electrodes. It would have been obvious to one with ordinary skill in the art at the time the invention was made provide a plurality of pairs of interdigitated electrodes in the microfluidic channel as taught by Bakewell et al. or Becker et al. in the invention of McBride et al. to, for example, optimize the apparatus for nucleic acid analysis (col. 14, ll. 40-49 in Becker et al. and the abstract in Bakewell et al.).

14. Claims 2 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morishima et al. ("Novel Separation Method on a Chip Using Capillary Electrophoresis in Combination with Dielectrophoresis", Micro Total Analysis Systems 2000, 269-272, May 14-18, 2000) in view of Bakewell et al. ("Characterisation of the dielectrophoretic movement of DNA in micro-fabricated structures", Inst. Phys. Conf. Ser. No. 163, January, 1999, pp.73-76).

Addressing Claim 2, Morishima et al. teach an apparatus for dielectrophoretic concentration of particles under electrokinetic flow (the abstract), comprising

a microfluidic channel section, the microfluidic channel section having a first end and a second end (Figures 1 and 2);

means for producing electrokinetic flow in the microfluidic channel section by producing a DC voltage across said first and said second end of microfluidic channel section (implied by Figure 1, which shows "DC voltage for CE"), said means for producing electrokinetic flow in the microfluidic channel section by producing a DC voltage across the first end and the second end of the microfluidic channel section comprising

a positive electrode connected to the first end of the microfluidic channel section (a positive electrode is clearly implied by the "cross" at the left end of the bottom view of Figure 1. One with ordinary skill in the art would recognize the "cross" symbol to represent a positive electrode, especially since it is labeled "DC voltage for CE [capillary electrophoresis]") and a negative electrode connected to the second end of the microfluidic channel section (a negative electrode is clearly implied by the stack of small line segments of decreasing length at the right end of the bottom view of Figure 1. One with ordinary skill in the art would recognize this stack of line segments forming an inverted triangle to represent a "ground" electrode.) and a DC power supply connected to the positive electrode and the negative electrode (implied or represented by "DC Voltage for CE" in Figure 1),

at least one pair of interdigitated electrodes located on a surface of each said microfluidic channel (Figures 1 and 2); the interdigitated electrodes comprising a first electrode plate having first electrode projecting legs and a second electrode plate having second projecting legs, the first electrode projecting legs and second projecting legs interlaced (Figures 1 and 2); and

means for producing the combination of dielectrophoresis and electrokinetic/electroosmotic flow by producing an AC voltage across the interdigitated electrodes (implied by Figure 1, which shows "High Frequency Electric Field for DEP

[dielectrophoresis]"), the means for producing the combination of dielectrophoresis and electrokinetic/electroosmotic flow comprising an AC power supply connected to the first electrode plate having first electrode projecting legs and the second electrode plate having second electrode projecting legs which sets up a non-uniform electric field proximate the first electrode plate having first electrode projecting legs and the second electrode plate having second electrode projecting legs, the non-uniform electric field collecting the particles (Figures 1 and 2).

Morishima et al. do not mention providing a plurality of pairs of interdigitated electrodes in the microfluidic channel. Bakewell et al. teach separating DNA in a microfluidic channel containing a plurality of pairs of interdigitated electrodes (in Baker et al. see the abstract and Figure 1). It would have been obvious to one with ordinary skill in the art at the time the invention was made provide a plurality of pairs of interdigitated electrodes in the microfluidic channel as taught by Bakewell et al. in the invention of Morishima et al. because this would optimize the apparatus for separating DNA.

Addressing Claim 4, see the rejection of claim 2 above, the limitations of claim 4 are also addressed by the detailed rejection of claim 2.

Final Rejection

15. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ALEX NOGUEROLA whose telephone number is (703) 305-5686. The examiner can normally be reached on M-F 8:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NAM NGUYEN can be reached on (703) 308-3322. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Alex Noguerola
May 6, 2003

NAM NGUYEN
SUPERVISORY PATENT EXAMINER
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